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# Abel Jansma

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I use machine learning, mathematics, and high-performance computing to understand emergent structures in complex systems. Experience in interdisciplinary teams at the interface of theory, experiment, and computation.

## Experience

**Research Fellow | University of Amsterdam | NL** **Nov 2024 - Present**
- Received a 3-year fellowship from the Dutch Institute of Emergent Phenomena to study the foundations and applications of emergence and higher-order structure in complex systems.
- Affiliated to the Institute of Physics (IoP) and the Institute for Logic, Language and Computation (ILLC).

**Postdoc | Max Planck Institute for Mathematics in the Sciences | GER** **Sep 2023 - Sep 2024**
- In the groups of Jürgen Jost and Bernd Sturmfels.
- Affiliated with Quantum Informatics at the University of Edinburgh to study parametrised quantum circuits.
- Deployed quantum machine learning code on QVMs (pyQuil, Qiskit) and QPUs (AWS Braket).

**Postdoc | University of Edinburgh | UK** **Oct 2022 - July 2023**
- Combined generative models, statistical physics, and causal inference to construct hypergraphs of genetic interactions and discovered novel and rare cell identities in populations of up to 100k transcriptomes.
- Inventor and lead R&D of the Stator software package, in an interdisciplinary team across physics, biology, and informatics, combining fundamental research with biomedical applications.

**Information Officer | SciPost | NL** **Oct 2017 - July 2018**
- Expanded the editorial board, profiling and contacting potential new editors.

**Junior Editor | SPUI25 | NL** **Feb 2017 - July 2017**
- Co-organised and presented monthly academic & cultural events for a broad audience.

**Distillation Engineer | Mediamatic | NL** **Sep 2016 - Feb 2017**
- Designed, built, and demonstrated a bespoke 30 litre vacuum still for artistic and olfactory research.

## Education

**PhD in Biomedical AI | University of Edinburgh | UK** **Sep 2018 - Dec 2022**
- Thesis: *Higher-order interactions in single-cell gene expression: Towards a cybergenetic semantics of cell state*
- Supervised by C. Ponting (Genetics and Cancer), L. Del Debbio (Physics), and A. Khamseh (Informatics).
- Graduated from the *Academy for PhD Training in Statistics* at the universities of Cambridge and Oxford.

**MSc Theoretical Physics | University of Amsterdam | NL** **Sep 2015 - July 2018**
- Thesis: $E_8$ *symmetry structures in the Ising model* (supervised by B. Nienhuis)
- Studied nonequilibrium physics and machine learning at the Niels Bohr Institute in Copenhagen.

**BSc Physics and Astronomy | University of Amsterdam | NL** **Sep 2012 - July 2015**
- Graduated with Honours/Cum Laude and a minor in Computational Science.

**Propedeuse in Art and Technology | HKU University of the Arts | NL** **Sep 2011 - July 2012**
- Art installations on collective behaviour, exhibited in the Netherlands, Germany, and Finland.

## Selected Publications & Talks

**Articles**

- Decomposing Interventional Causality into Synergistic, Redundant, and Unique Components - Jansma (NeurIPS spotlight, 2025)
- The Fast Möbius Transform: An algebraic approach to information decomposition - Jansma et al (Phys. Rev. Res., 2025)
- A Mereological Approach to Higher-Order Structure in Complex Systems: from Macro to Micro with Möbius - Jansma (Phys. Rev. Res., 2025)
- High Order Expression Dependencies Finely Resolve Cryptic States and Subtypes in Single Cell Data - Jansma et al. (Mol. Syst. Biol., 2025)
- Superdense Coding and Stabiliser Codes with Ising-coupled Entanglement - Jansma (2024)
- Higher-Order Interactions and Their Duals Reveal Synergy and Logical Dependence beyond Shannon Information - Jansma (Entropy, 2023)
- A Compositional Game to Fairly Divide Homogeneous Cake - Jansma, A (2023)

**Conferences**

- A causal calculus of parts and wholes - ILIAD conference, USA, 2025 (talk)
- Analogy Machines: with Melanie Mitchell, Han v.d. Maas, Jules Hedges, Martha Lewis - NL, 2025 (organiser)
- Higher-order in-and-outeractions - DEMICS23, GER, 2023 (talk)
- A compositional game to fairly divide homogeneous cake - Applied Category Theory 2023 (poster)
- Model-free estimation of higher-order interactions - CSHL Biology of Genomes conference, USA, 2021 (poster)
- Higher-order interactions in single-cell expression data - European Mathematical Genetics Meeting, FR, 2021 (talk)
- Higher-order interactions in single-cell expression data - CSHL Network Biology conference, USA, 2021 (poster)

**Invited Talks**

- From Macro to Micro with Möbius - UvA Institute for Advanced Studies, NL, 2025
- A Compositional approach to higher-order structure in complex systems - Imperial College London, UK, 2024
- A unified approach to higher-order structure in complex systems - University of Leipzig, GER, 2024
- The information theory of higher-order interactions - UvA Institute for Advanced Studies, NL, 2023
- Complex networks in the mouse brain - IGC Biomed. Genomics, UK, 2021
- Searching for strange loops in mouse brains - Math. Quantum Physics Seminar, University of Innsbruck, AT, 2021
- Higher-order information lattices - Math. Quantum Physics Seminar, University of Innsbruck, AT, 2021

## Honours & Awards

**Protocol Fellowship Grant ($7.5k) | Ethereum Foundation | GER** — **Nov 2022 - March 2023**

**Science Communication Grant | Genetics Society | UK** — **April 2019**

**Technology Scholarship ($10k)| ASML | NL** — **Sep 2015 - Sep 2017**

## Volunteering

**Co-host | Computational Biology Journal Club** — **Feb 2019 - March 2020**

**Beekeeper | Anna's Tuin en Ruigte** — **Oct 2017 - July 2018**

**Reader | VoorleesExpress** — **Nov 2016 - Nov 2017**

- I read books to children to stimulate language development and promote reading.

**Committee member | BetaBreak** — **Dec 2014 - Jan 2016**

- Moderated and organised public debates on science & society at Amsterdam Science Park.

## Languages

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| **Natural** | Dutch (native), English (fluent), German (fluent), French (basic) |
| **Programming** | Python (SciPy, PyTorch, Qiskit, *etc.*), R, Nextflow, SGE, Git, Haskell, Arduino (C++) |